NON-TERATOMATOUS BONE FORMATION IN THE HUMAN OVARY.[1]

By George W. Outerbridge, M.D., F.A.C.S.,

ASSISTANT INSTRUCTOR IN GYNECOLOGY AND IN SURGICAL PATHOLOGY IN THE UNIVERSITY OF PENNSYLVANIA; ASSISTANT GYNECOLOGIST TO THE METHODIST HOSPITAL; ASSISTANT SURGEON TO THE GYNECEAN HOSPITAL, PHILADELPHIA, PA.

In 1912 two French surgeons, Pozzi and Bender, published a paper in which they discussed at some length the question of bone formation in the ovaries and Fallopian tubes other than that of teratomatous origin, and reported two personal observations of this condition in the ovary. They also stated their belief that such ossification of the ovary is of extremely rare occurrence, since they were able to find in the literature mention of but 5 additional cases which they considered reasonably authenticated, although in a number of other instances specimens had been reported as falling in this category which on investigation were found to have been too imperfectly studied to be accepted. These 7 definite cases are divided by Pozzi and Bender into the following groups: 2 ossified ovarian fibromata, 2 ovarian cysts with ossification of the walls, 2 cases of diffuse ossification in sclerotic ovaries, and 1 ossified corpus luteum.

Since two cases of ovarian ossification happened to come under my observation shortly after the appearance of Pozzi and Bender's article, I was rather surprised by their statement as to the extreme rarity of the condition, and was somewhat skeptical of the accuracy of this view. A fairly careful search through the literature, both antedating and subsequent to their paper, has brought to light a few additional reports, bringing the total of what may be considered fairly well-authenticated cases up to about 14. While this may not represent an absolutely complete list, the number of reports is certainly surprisingly small in view of the considerable amount of literature which exists upon the subject of abnormal ossification in other portions of the body.

The occurrence in ovaries of little hard nodules, often called "ovarian stones," is well recognized as a not exceedingly infrequent phenomenon, but these are usually considered merely calcareous deposits in sclerotic ovaries or degenerated corpora lutea, and are probably in most instances never subjected to microscopic examination, without which the definite determination of the presence of bone is hardly possible. In order, therefore, to ascertain whether or not the occurrence of true bone in the ovary (aside from that formed in dermoids and solid teratomas) is really as unusual as has apparently been assumed, I have subjected to microscopic examination, after thorough decalcification, sections from all ovaries containing hard nodules which have come into my hands. In this manner 7 specimens have been studied, with the result that areas of true bone have been found in every one, sometimes of greater extent, sometimes, of lesser, but always clearly demonstrable. The material was derived from the following sources: 5 cases from the gynecological service of the Hospital of the University of Pennsylvania (Dr. John G. Clark), 1 case from the Gynecean Hospital (Dr. Henry D. Beyea), and 1 case from the gynecological service of the Methodist Hospital (Dr. William R. Nicholson). In every instance microscopic examination of sections taken from various areas failed to reveal anything suggestive of a teratomatous process.

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[1] Presented before the Pathological Society of Philadelphia, May 13, 1915.

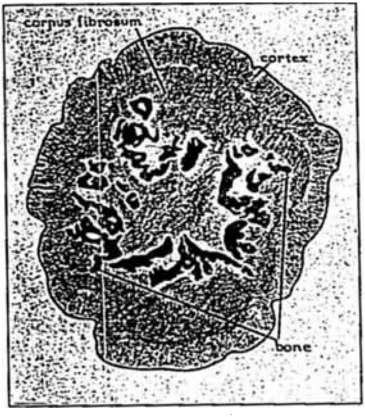

Fig. 1.—Case I. Sketch-drawing of section through the entire nodule. Very low power.

Case I.—U. Pa., No. 2261. This patient, a girl, aged twenty years, was operated upon by Dr. Clark in 1909, during my term of internship on his service at the University Hospital. The left ovary was somewhat cystic and the right contained a small, very hard nodule. A partial resection of each ovary was performed, with removal of the appendix. The specimen received at the laboratory consisted of "the wall of a corpus luteum hematoma from the left ovary, with a firm, calcified mass, measuring 1.7 x 1.6 x 1.4 cm., from the right;" no histological examination of the hard nodule was originally made, merely a diagnosis of "right oöphoritis interstitialis chronica (with calcareous degeneration)" being returned by the pathologist. On becoming interested in this investigation I looked up the specimen and found the little nodule intact. Owing to the length of time it had lain in preserving fluids, decalcification was difficult and the soft parts had lost much of their staining properties; the sections obtained, although clearly showing the presence of true bone, were hardly satisfactory for photomicrographic purposes, and therefore merely a sketch drawing of the entire section through the nodule is presented, to show the relations between the ovarian cortex, corpus fibrosum, and the numerous areas of bone forming an incomplete ring or shell within the circumference of the latter (Fig. 1). The tissue in the centre of this bony ring is somewhat looser in structure than that forming the outer portion of the corpus fibrosum, external to the bone. The latter is arranged in wavy, more or less parallel lamellæ, with rather sparse bone bodies; the structure is distinctly compact, but without any very definite Haversian systems.

Summary. This case presents an example of ossification within a corpus fibrosum; the ovary was otherwise normal, and there were no marked inflammatory changes in the pelvic organs.

CASE II.—U. Pa., No. 3478. Aged forty-six years. *Clinical diagnosis:* pelvic abscess; pelvic inflammatory disease; tuboövarian abscess. *Operation* (Feb. 7, 1913): vaginal puncture; supravaginal hysterectomy; bilateral salpingoöphorectomy. *Specimen:* myomatous uterus; large right tuboövarian abscess; left hydrosalpinx; *left ovary.* The latter measures 4 x 2.5 x 2 cm.; it is closely adherent to the outer end of the tube, and on section is seen to contain a large degenerating corpus luteum, in which is a considerable area of bony hardness. *Microscopically,* the left ovary shows a fairly normal cortex, closely fused with the wall of the pyosalpinx (Fig. 2). The most prominent feature of the specimen is a good-sized corpus fibrosum, which in some sections shows an almost complete ring or shell of deeply staining calcareous material, with a few small but distinct areas of bone along its inner border. The central area is filled with a loose, richly vascularized tissue, with considerable interstitial hemorrhage. In other sections, cutting through a slightly different plane (Figs. 3 and 4) extensive masses of bone are seen running all through this central softer tissue, which here presents an appearance strongly suggestive of marrow. The bone appears to have formed in the central cavity of the calcareous shell, with which it is everywhere in intimate relationship (Fig. 5). It is fairly compact, with numerous bone bodies in small lacunæ, and indications of Haversian system formation, although this is not very distinct.

Summary. This case presents an example of ossification within a fairly extensive calcareous shell formed in a corpus fibrosum; the ovary was otherwise normal, save for dense adhesions to the greatly inflamed tube.

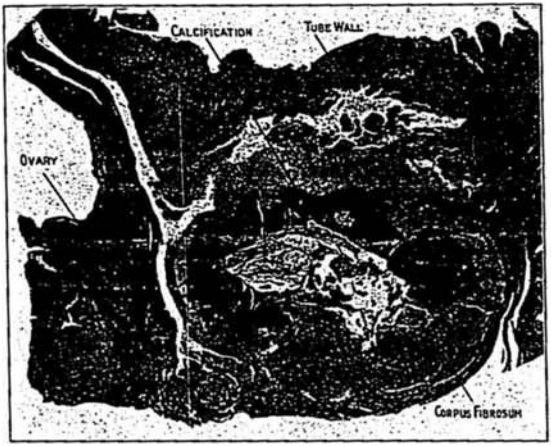

FIG. 2.—Case II. Low-power photograph showing calcareous shell formed within a large corpus fibrosum. (The areas of bone in this section are too small to be distinguishable at this magnification.)

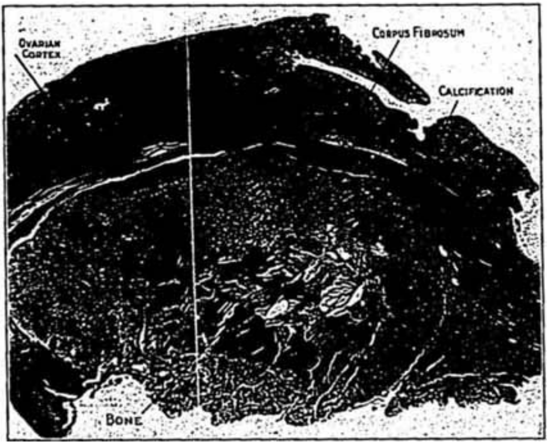

FIG. 3.—Case II. Low-power photograph of a section from a different block of tissue, showing an extensive area of bone in the centre of the corpus fibrosum.

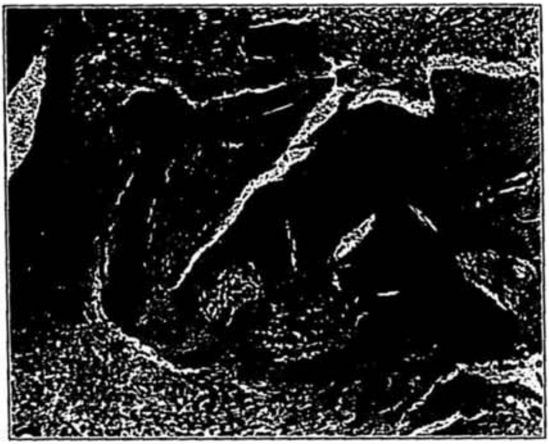

FIG. 4.—Case II. Higher power view of a portion of the bone shown in Fig. 3.

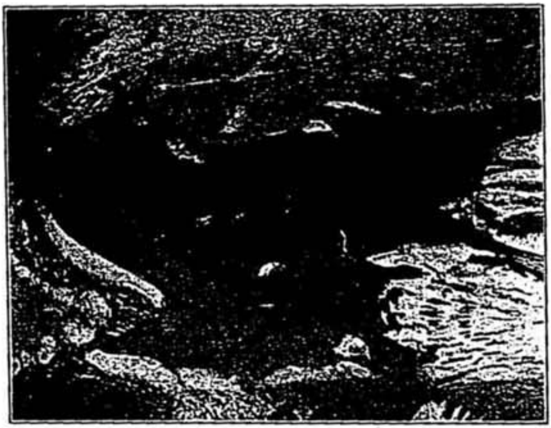

FIG. 5.—Case II. High-power view of another field, showing relationship between fibrous tissue (corpus fibrosum) above, zone of calcification in the middle, and bone below.

CASE III.—Gyn. Hosp., No. 6577. Aged thirty-eight years. *Clinical diagnosis:* bilateral pyosalpinx. *Operation* (Feb. 25, 1913): bilateral salpingectomy; left oöphorectomy; suspension of right ovary. The left adnexa formed an inflammatory, partially cystic mass, which ruptured during removal, permitting the escape of a considerable quantity of pus; drainage. *Specimen:* both tubes; left ovary; small hard nodule. The right tube forms a typical retort-shaped pyosalpinx 11 cm. in length; the fimbriæ are not completely agglutinated, however, and the abdominal extremity is slightly patulous. The left tube forms an indefinite inflammatory mass about 6 x 4 x 3 cm., buried in dense adhesions. The *left ovary* is represented by a mass of torn tissue measuring 5 x 4 x 2.5 cm., which has apparently formed the wall of a cyst or abscess cavity. Accompanying it is a small nubbin of bony hardness, about 2 cm. in diameter, which was shelled out from the left ovary. *Microscopically,* both tubes show intense inflammatory changes. The left ovary (soft portion) shows intense infiltration of the stroma by small round cells. There is one good-sized cyst, apparently of follicular origin. A section through the hard nodule shows the characteristic structure of a corpus fibrosum, with here and there small bits of ovarian stroma about the edge. Throughout the fibrous tissue are extensive areas of calcification, in most of which there is no evidence of bone formation. At one point, however, near the centre of the section, there is a small but distinct mass of true bone, having an irregular outline sharply defining it from the surrounding fibrous tissue, and presenting a similar structure to that of the preceding specimens.

Summary. This case presents an example of a small amount of ossification, occurring in conjunction with extensive calcification of a corpus fibrosum in an ovary the seat of acute inflammation, and associated with purulent processes in each tube.

CASE IV.—U. Pa., No. 3880. Aged thirty-four years. *Clinical diagnosis:* multiple fibroid tumors; bilateral hydrosalpinx. *Operation* (March 25, 1914): supravaginal hysterectomy; bilateral salpingoöphorectomy; appendectomy. *Specimen:* myomatous uterus; tubes; ovaries; appendix. Each tube has been transformed into a typical hydrosalpinx, showing microscopically very active and extensive inflammatory changes. The right ovary is buried in adhesions, but is otherwise grossly and histologically normal. The *left ovary* measures 3.5 x 3.5 x 2.5 cm. Its surface is everywhere covered by adhesions; it is slightly cystic, and at one point contains a small bit of hard, bone-like tissue, less than 1 cm. in diameter. *Microscopically,* the left ovary shows a good-sized serous pseudocyst on the surface and a smaller Graafian follicle cyst within its substance. For the rest, the ovary is histologically normal, the cortical tissue being well developed and containing a moderate number of primordial follicles. Scattered throughout are about the usual number of corpora fibrosa, in the largest of which are seen a few small, irregular plaques of bone (Figs. 6, 7,

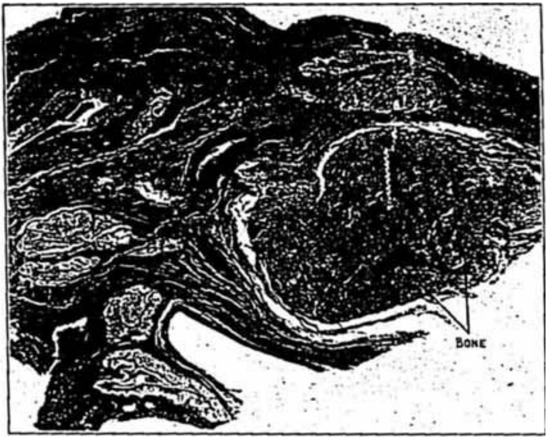

FIG. 6.—Case IV. Low-power view of section through entire ovary, showing numerous corpora fibrosa, in the largest of which are two small areas of bone.

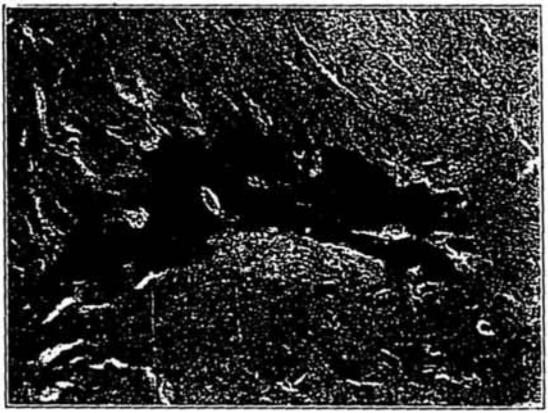

FIG. 7.—Case IV. Higher power view of one of the bone areas shown in Fig. 6.

and 8). These lie within the substance of the fibrous tissue or along its edge. They present the same general characteristics as the specimens described above. The bone is arranged in somewhat irregular lamellæ, scattered unevenly throughout which are numerous small lacunæ, each containing a single deeply staining cell. True Haversian system formation can not be definitely distinguished, but here and there are good-sized cavities, each containing a small capillary bloodvessel surrounded by very loose connective-tissue, presenting an appearance very similar to that of ordinary marrow. The bony areas present everywhere an extremely irregular, dentated edge. There are no evidences in this specimen of a previous focus of calcification, such as are present in Cases II and III.

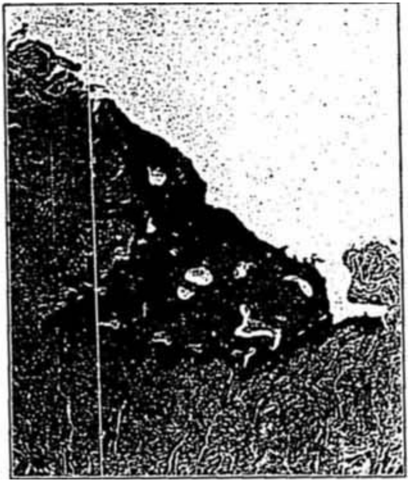

FIG. 8.—Case IV. Photograph from another block of tissue, showing an area of bone on the edge of the corpus fibrosum.

Summary. This case presents an example of small foci of ossification, apparently without previous calcification, occurring in a corpus fibrosum in an ovary otherwise normal save for the presence of small retention cysts, but associated with old pelvic inflammatory disease.

CASE V.—U. Pa., No. 3893. Aged sixty-eight years. *Clinical diagnosis:* Carcinoma corporis uteri. *Operation* (April 2, 1914): panhysterectomy; bilateral salpingo-oöphorectomy. *Specimen:* uterus;

tubes; ovaries. The uterus, including cervix, measures 8 x 6.5 x 4 cm. It contains a small fibroid; the endometrium is greatly thickened, and presents histologically the characteristic picture of advanced adenocarcinoma, with extensive involvement of the muscularis. The tubes show grossly and microscopically moderate inflammatory changes. The right ovary is represented merely by torn remains of a thin-walled cystic sac. The *left ovary* forms a roughly spherical cyst, about 4.5 cm. in diameter, which has been ruptured. The surface is everywhere covered with adhesions. The cyst wall is for the most part thin and delicate, but in one area is considerably thickened, presenting on the inner surface of this portion several whitish, nodular elevations of almost bony hardness. *Microscopically,* sections from both ovaries show a distinctly fibrous ovarian stroma, containing numerous small cystic spaces lined with a single layer of columnar epithelium, and suggesting on first sight a metastatic invasion from the uterine cancer, but on closer examination the lining epithelium is seen to be so regular, and to show so little tendency to active proliferation, that these formations must be considered probably merely cystic ingrowths from the surface epithelium of the ovary. For the rest, the ovarian stroma appears normal, with numerous developing follicles and corpora fibrosa. The cyst cavity has lost its lining epithelium; it presents the typical appearance of a retention cyst of inflammatory origin. Section through the hard masses shows a loose fibrous stroma, with at one point a good-sized developing Graafian follicle. The major portion of the section consists of very numerous irregular trabeculæ of bone, presenting an appearance practically identical with that shown in Figs. 4 and 13, and having in the interstices a soft, marrow-like tissue similar to that shown in the latter. The Haversian system formation is rather more distinct in this specimen than in any of the others.

Summary. This case presents an example of extensive ossification in a somewhat cystic ovary, associated with pelvic inflammation and an adenocarcinoma of the uterus.

CASE VI.—U. Pa., No. 4117. Aged fifty-three years. *Clinical diagnosis:* ovarian cyst. *Operation* (Oct. 31, 1914): Right oöphorectomy. *Specimen: right cystic ovary,* measuring 30 cm. in diameter. The external surface is pinkish white, smooth in places, covered with fibrous adhesions in others. On section the cyst is seen to be unilocular and filled with yellowish, slightly glairy fluid. The cyst wall is for the most part about 2 to 3 mm. in thickness, but at one point there is a hard nodule measuring about 4 x 3 cm. in area by 1.5 cm. in thickness, projecting slightly above the general surface externally, but much more markedly on the internal aspect of the cyst, where it forms a distinct protuberance into the cyst cavity. It presents here the general appearance of being the site of old scar tissue which has undergone considerable contraction, several folds or plicæ of the cyst wall extending outward from it in a radial manner. It is covered with the same smooth tissue lining the entire

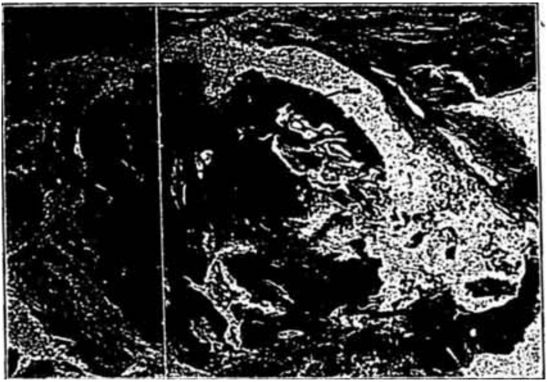

Fig. 9.—Case VI. Low-power photograph of calcified nodule, containing an area of true bone, in the wall of an ovarian cyst.

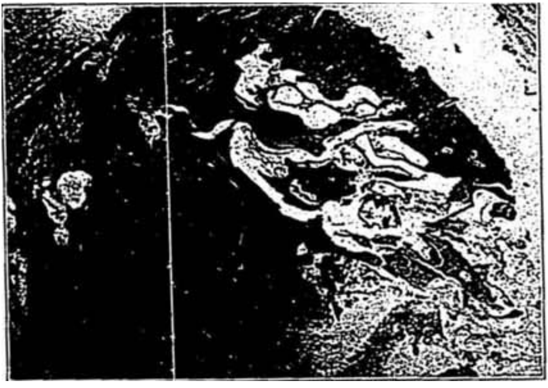

Fig. 10.—Case VI. Higher power view of the area of bone.

cyst cavity, and there is nowhere any evidence of skin, hair, sebaceous matter, or other dermoid constituents. The nodule is so hard that it can be cut only with a saw. *Microscopically*, sections from the soft portions show the cyst wall to be composed of parallel, wavy bundles of fibrous tissue containing numerous bloodvessels. At one point a somewhat flattened-out cystic follicle is seen. The main cyst cavity is lined by a single layer of low columnar to cuboidal epithelium, such as is characteristic of the serous cystadenoma. Sections through the hard nodule all show extensive areas of calcification throughout the fibrous tissue, which is here distinctly denser and more hyaline in character than in the precedng sections, with here and there good-sized irregular masses of bone (Figs. 9 and 10). The latter has apparently been formed in close relation to the areas of calcification and secondarily to this process. For the most part this bone, which is quite compact, is present in the form of a central plug or lining inside the calcareous shell, exactly as in Case II; but here and there good-sized trabeculæ of bone extend out through the surrounding fibrous tissue, with which they are in intimate relation, without any intervening zone of calcification.

Summary. This case presents an example of extensive calcification and ossification in one portion of the wall of a cystadenoma serosum of the ovary.

CASE VII.—Methodist Hosp. Aged twenty-two years. *Clinical diagnosis:* retroversion; pelvic inflammatory disease. *Operation* (July 10, 1914): dilatation and curetment; amputation of cervix; appendectomy; suspension of left ovary; removal of hard nodule from Douglas's pouch. This case presents some features of unusual interest. On opening the abdomen the uterus was found to be normal in size and somewhat retroverted; there were a few delicate adhesions in the pelvis, which were broken up without difficulty; the left tube and ovary were normal, but the right adnexa could not be located. The right uterine cornu ended in a little nubbin of tissue, not more than 0.5 cm. in length, apparently corresponding to the stump of the tube, but beyond this no trace of that organ was present, nor were there such dense adhesions in this region that there was any possibility of the tube remaining unrecognized among them. The ovary, likewise, was lacking from its normal situation, and nothing corresponding to it could at first be discovered; but on inserting the hand well down into Douglas's pouch, this was found to be occupied by a tag of omentum, embedded in which was a little stony nodule. It was at first thought that this might be an unusually large phlebolith, although this would be a rather uncommon situation for such a formation; but on more thorough exposure it was seen to be just about the size and shape of a normal or slightly shrunken ovary. It was removed simply by shelling it out from the omental tissue. *Specimen:* an almond-shaped mass, measuring 2.5 x 1.5 x 1 cm., of bony hardness, having a somewhat wrinkled external surface. No soft tissue whatever was discernible grossly, the nodule presenting the appearance merely of a bit of dense bone or calcareous material. It was sawed in half longitudinally, and on section presented the same solid appearance. Decalcification was tedious, requiring many weeks, but finally it was possible to embed the tissue and cut microscopic sections.

Microscopically, a longitudinal section through the entire specimen (Fig. 11) shows the following characteristics: Externally there is a narrow ring of fibrous tissue, arranged in more or less parallel bundles, and containing numerous small bloodvessels and many minute foci of calcification. Here and there bits of fat are adherent to the external surface. For the most part this zone of fibrous tissue remains exceedingly narrow, but in one or two places it dips down somewhat into the interior, being here distinctly looser in structure than on the periphery. By far the major portion of the specimen within the fibrous capsule, however, is made up of multitudinous bony trabeculæ, the whole greatly resembling a section through a piece of ordinary spongy bone. The trabeculæ are fairly thick in the cortical region, forming here good-sized solid masses of bony tissue (Fig. 12); but as the centre is approached they become thinner and more delicate (Fig. 13). The interstices between them are filled with an exceedingly loose areolar tissue, presenting practically the appearance of ordinary marrow, and containing many fat cells, numerous small capillary vessels, and here and there

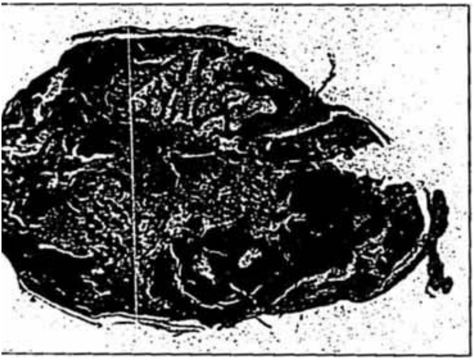

Fig. 11.—Case VII. Very low-power view of a longitudinal section through the entire specimen. The fibrous capsule is seen about the periphery, somewhat mutilated. The grayish areas in the cortex, especially near the right end of the section, correspond to the degenerated tissue mentioned in the description. The bony trabeculæ constituting the major portion of the specimen are well shown. The pale area in the centre is loose fibrous tissue.

areas of small round-cell infiltration. In addition to these types of tissue there are several large areas of granular material, taking in hematoxylon-eosin preparations a dull bluish stain, and apparently representing greatly degenerated stroma tissue; throughout these a few small foci of calcification are seen. Some of these degenerated areas are completely structureless, while in others the more or less vague outlines of numerous small bloodvessels can be made out, together with many brownish pigmented cells, such as are often seen in the neighborhood of degenerated corpora lutea. In one of the largest of these areas there are a couple of large, irregular cavities, with ragged edges and masses of apparently cellular detritus in the centre; the general appearance of these suggests that they may very probably represent the remains of somewhat cystic follicles, but the tissue is so degenerated that it is impossible to determine this with certainty. It is evident that the extensive degeneration of this tissue must have taken place *intra vitam* and not merely as a result of the long sojourn of the specimen in the decalcifying fluid, since the outer zone of fibrous tissue, the fat adherent to it, and the medullary tissue throughout the specimen are all exceedingly well preserved.

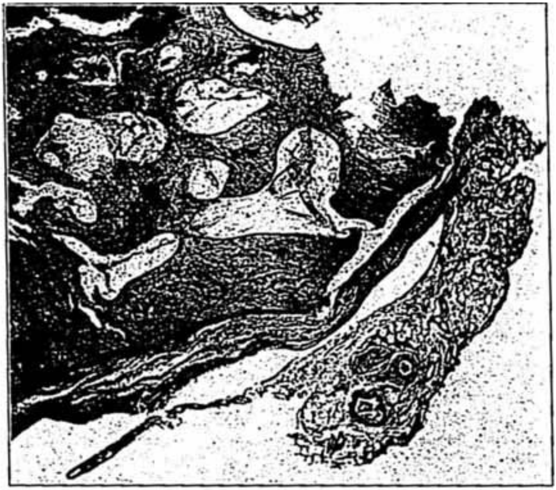

FIG. 12.—Case VII. Higher power view of a portion of the cortex, showing fibrous capsule, with bit of adherent fatty tissue, and thick trabeculæ of bone.

Summary. This case presents an example of complete atrophy of the right tube, with absence of the right ovary from its normal situation, this structure being apparently represented by an almost completely ossified mass of tissue attached to a tag of omentum deep down in Douglas's pouch.

On account of the almost complete ossification of the little nodule in this case, together with the degeneration of the few areas of soft tissue remaining, it can not, it must be admitted, be identified with absolute certainty as ovary. In view, however, of the entire absence of anything else corresponding to the ovary on the right side, with the associated atrophy of the tube, and in consideration of the form, size, location, and at least suggestive microscopic findings detailed above, by far the most plausible explanation for this little bony nodule would seem to be that it represents the remains of the right ovary, which has undergone a spontaneous separation from its normal attachments, with secondary degenerative changes. This opinion finds considerable support from a study of the literature, in which reports of a number of more or less similar cases are to be found. The occurrence of partial or complete atrophy of the adnexa of one side, associated with a normal uterus and opposite adnexa, has been noted from

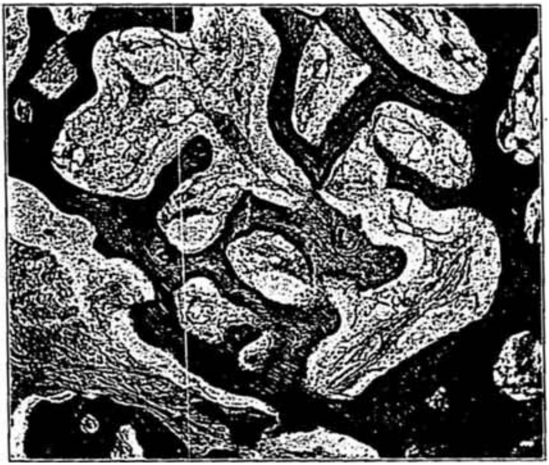

FIG. 13.—Case VII. High-power view of the more delicate bony trabeculæ from the central portion of the specimen; showing also medullary tissue between them.

time to time, but until the first fairly comprehensive study of the subject by Rokitansky, in 1860, such cases were always considered due to developmental anomalies. Rokitansky reported 15 cases in which some degree of atrophy had occurred, usually associated with detachment of the adnexa from their normal relations, and showed that definite pathological processes, occurring either during intra- or extra-uterine life, but *subsequent* to the primary formation of the organs in question, may be responsible for this condition.

Since that time quite a few writers have interested themselves in this subject, and our knowledge of it has been enriched by numerous reports of cases. In the chapter on Diseases of the Ovary in Veit's *Handbuch*, 2d ed., Pfannenstiel says that in cases of this sort "both organs (tube and ovary) are usually lacking from their normal situation, or only the ovary may be entirely absent; if present at all, however, the latter is usually at least atrophic, shrunken, or otherwise pathologically altered. It is often found to have formed an anomalous attachment somewhere in the abdomen; for instance, to the omentum, on the pelvic brim, in Douglas's pouch, or on the urinary bladder. Under these circumstances it is usually greatly shrunken, necrotic, and at times calcified, or transformed into a sac filled with old blood clot." Frankl, in his recently published *Pathological Anatomy and Histology of the Female Genital Organs*, declares that "cases of complete amputation of the ovary, which then lies as a shrunken mass in Douglas's pouch, are not exceedingly rare," and in a paper published last year, Ogórek was able to collect nearly a hundred examples of spontaneous amputation of the uterine adnexa from their normal attachments. After careful consideration of all features of the question, Ogórek, in common with most modern authorities, has come to the conclusion that such separation may occur in only two ways: either as the result of (1) *torsion*, or (2) *strangulation by inflammatory peritoneal bands*, the former occurring when free mobility of the adnexa exists, the latter when these organs are more or less fixed by adhesions to surrounding structures. Once such separation has taken place, he says, the bit of tube left attached to the uterus shrinks to a small nubbin, whose appearance is identical with that of the stump often left after a salpingectomy. The detached distal portion of the tube in many instances undergoes necrotic changes and is absorbed; in others it may remain as an unrecognizable tissue mass somewhere in the pelvis, or may even wander into some distant portion of the abdomen.

The first of these conditions—*i. e.*, a small nubbin of tube at the uterine cornu, with complete absence of the remainder—is exactly that which was present in the case under discussion. In place of the ovary at its normal situation, the oval mass of bony tissue described above was found attached to the omentum deep down in

Douglas's pouch. It is easy to comprehend that following a spontaneous amputation of the right adnexa, whether due to torsion or strangulation, but probably the latter, the ovary in this instance, instead of undergoing necrosis and complete disappearance like the tube, formed new attachments to the omental tissue. With the great disturbances in its nutrition that must have followed, however, degeneration, calcification, and finally ossification were not unnatural sequelæ, and no doubt represent the actual sequence of events. While I have not been able to find any record of an exactly parallel case of histologically demonstrated *ossification* of a spontaneously amputated ovary, it seems most probable that such would have been brought to light had more careful studies of such organs been made. Rokitansky, indeed, in his paper of 1860, speaks of several cases in which the detached or twisted ovary showed a calcareous or bony consistency; but it is evident from his descriptions that at least some of these were dermoids, and, at any rate, pathological knowledge was too undeveloped at that time to make his opinion on this point of value. In the more recent literature at least two cases have been reported which present striking points of similarity to the one under discussion; both these are described by their authors as cases of *calcification* of the ovary, but as no microscopic examination was made in either instance, the possibility that in reality ossification may have been present can not be excluded. These cases are briefly as follows:

Prince (1895). "Miss B., aged forty years; examination revealed a uterus studded with small fibroids. . . . On passing my fingers (at operation) over the posterior surface of the uterus they came in contact with a hard body, loosely adherent, and easily separated from its attachments to the uterus. The right ovary was present and cystic. This with the tube was removed. The left ovary and tube were absent; all that remained was a short stump of the tube about one-fourth inch long. On examining the hard body removed from the posterior surface of the uterus it was found to be the exact size and shape of the ovary. It was free in the pelvic cavity save for the very slight attachment to the uterus by its rough surface. The ovary must have attained full size in its normal position, when for some cause it became detached with the tube, probably from some constricting agency, which has done a neater amputation than could have been done by any surgeon. All vestige of any constricting band, or of the amputated tube, had disappeared."

Miländer (1903). The patient was aged twenty-one years; a nullipara. A large cyst with twisted pedicle was present on the right side; "the left broad ligament was very delicate, the left tube very thin, and its distal extremity not to be found. On careful examination a flat, almond-shaped body was found on the left side in Douglas's pouch, with its long axis transverse, lying free on the peritoneum, from which it was removed with forceps. This free body was found to be the calcified left ovary; in places it was of stony hardness, in others less dense. It measured 2.8 x 1.6 x 0.8 cm.; the surface was rough and irregular. On section various small, hard masses could be lifted out with forceps, evidently calcified corpora lutea." The author suggests that the calcification was due to disturbances in nutrition caused by pressure of the cyst on the opposite side.

Returning to the question of ossification of normally situated ovaries, there are, as has been said, surprisingly few cases on record. Those mentioned by Pozzi and Bender, in addition to their own, were reported by Fürst, Pfannenstiel, Schroeder, Strauch, and Waldeyer. In going through the literature, I have come across the following additional instances, the essential features of which are here given as briefly as possible:

Winckel (1886). A completely ossified ovary, the size of an adult head, measuring 40 x 40 x 15 cm.; the interior cystic, the cyst wall of bony hardness, showing in thin sections (ground, not decalcified) typical lamellæ and bone bodies.

Coe (1892). One ovary the seat of cystic degeneration, the other of chronic ovaritis; the latter contained a small, hard nodule, which microscopic examination showed to be true bone. Centre of nodule gelatinous, consisting of bone marrow. No evidences of dermoid.

Copeland (1892). Hard growth in each ovary, so dense that it was almost impossible to cut through them with a jeweler's saw. A thin piece secured by grinding presented the histological appearance of longitudinally cut bone.

While the presence of true bone in these cases of Coe and Copeland appears to have been fairly well confirmed by microscopic examination, Williams (1893) contended that both were merely examples of calcification, and expressed his belief that "it is very doubtful if true ossification occurs, although a few apparent cases have been reported."

Robertson (1912). Right ovary 12.5 x 15 cm., of bony hardness. When sawed through, found to consist of a solid wall with a cavity in the centre filled with grayish material. A section of the bony mass made by grinding a thin fragment on a water stone showed atypical bony tissue with irregular spaces and canals; no typical Haversian systems; no evidences of teratoma. The author thinks the bone represents a metaplasia of fibrous tissue.

Moschowitz (1913; 2 cases). Case I.—Double salpingo-oöphorectomy for tubal tuberculosis. In the right ovary a dense nodule having a convoluted surface. On section "the outer third of this nodule was found to be composed of lime salts with many cavities, around which conversion into true bone is taking place. The central portion of the mass consists of true bone, with lamellæ, bone cells, and Haversian canals containing well-formed bloodvessels, fibrous tissue, and fat. The ossification is evidently spreading eccentrically." Case II.—Hard mass the size of a pecan in centre of ovary. Findings similar to those in Case I, but more advanced.

Adachi (1913). Left ovary measures 2 x 1.5 x 1 cm. At one edge a somewhat hard mass palpable; after decalcification easily recognized as a corpus albicans, with an area of calcification and irregular trabeculæ of well-formed, compact bone, containing spaces evidently marrow cavities, and Haversian canals. In the marrow tissue connective-tissue cells, myeloblasts, myelocytes, plasma cells, lymphocytes, erythrocytes, etc.; no osteoblasts. Bony tissue is in central portion of the area of calcification.

In addition to the above-mentioned cases it is of course possible that other instances may be scattered through the literature, but in view of the fact that I have been able to collect from a moderate amount of pathological material no less than 7 additional ones in a comparatively short space of time (all but one of these occurring within two years), it certainly seems that the condition must be far more common than might be assumed from a study of the literature.

The question naturally arises as to the origin of the bone in cases of this type. The first thought might be that it is always a teratomatous manifestation, in view of the frequent occurrence of such tumors in the female sexual glands and of their well-known tendency to produce bony tissue. Even in cases such as those reported in the present communication, where careful microscopic examination has failed to reveal the least indication of other abnormal tissues, the argument might be advanced that we are here dealing with examples of the so-called "reduced" teratoma, in which it may be assumed that all varieties of tissue save one have been suppressed, as is believed to be the case in certain thyroid-like and other anomalous growths of the ovary. This theory I have discussed at some length in a previous paper, and do not therefore wish to enlarge upon it here. Suffice it to say that while this hypothesis has many points in its favor in the case of growths consisting of highly organized glandular tissue, such as thyroid, a much simpler and more plausible explanation for the occurrence of bone in the ovary would appear to be that it arises as a result of metaplastic changes in the fibrous tissue with which that organ is so well supplied. The tendency of old fibrous tissue, especially if the seat of chronic inflammatory processes, to undergo calcification is of course well known. The occurrence of true ossification in such areas is also a matter of frequent observation, and, indeed, abnormal ossification has been noted in almost all parts of the body, especially the muscular system, bloodvessels, old scars, etc., and cases have been reported involving the kidney, penis, thyroid, pleura, lymph glands, and various other organs.[2] In several of the cases considered in the present paper the ossification was located in the substance of a corpus fibrosum, *i. e.*, in an area of more or less inert, avascular fibrous tissue; in others, in the fibrous tissue of a cyst wall, or in an atrophic, degenerated organ. In a number of cases the ovary affected was associated with a chronic pelvic inflammatory process of high grade. In almost all instances the ossification was evidently secondary to more or less extensive calcareous deposits in the fibrous tissue, and in the instance where this was most markedly absent (Case IV) the ovary was otherwise wholly normal, save for perioöphoritic adhesions, and in no way suggested the existence of a teratomatous neoplasm.

In addition to the above arguments it may be mentioned that most authors who have interested themselves in this subject have likewise arrived at the conclusion that the bone is purely metaplastic in origin rather than neoplastic. The best term to apply to the condition would therefore appear to be "ossificatio ovarii" rather than "osteoma," notwithstanding the use of the latter by Pfannenstiel and one or two others.

CONCLUSIONS. As a result of the study of 14 cases from the literature and of 7 personal observations it appears that true ossification of the ovary may occur independently of any neoplastic or teratomatous process. Such bone formation is probably metaplastic in character; it occurs chiefly in corpora fibrosa or fibrous portions of the stroma, and particularly in ovaries from cases of pelvic inflammation. In one instance of the personal series it involved the wall of a serous cystadenoma, and in one a spontaneously amputated ovary which was found adherent to the omentum at the bottom of Douglas' pouch, associated with complete atrophy of the corresponding tube. It is highly probable that true ossification of the human ovary, of non-teratomatous origin, is far more common than has generally been believed.

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[2] An extensive bibliography of this subject will be found in the recent monograph of Gruber on Myositis Ossificans.

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GANGRENE OF THE LUNG FOLLOWING ARTIFICIAL PNEUMOTHORAX.

By Edward N. Packard, Jr., M.D.,

ASSISTANT ATTENDING PHYSICIAN TO THE RECEPTION HOSPITAL,
SARANAC LAKE, N. Y.

Gangrene of the lung in pulmonary tuberculosis is a very rare condition. Gangrene of the compressed lung in a patient treated with artificial pneumothorax is exceedingly rare; in fact, no case, to the writer's knowledge, has thus far been reported in literature. The following is a report of such a case, with autopsy.

The patient was an American, aged forty-one years; single; teacher. His father died of pulmonary tuberculosis, aged sixty-nine years.

The patient had had numerous attacks of gonorrhea many years before.

The present illness began with a cold. This he was unable to throw off, and three months later definite physical signs were found, and there were tubercle bacilli in the sputum. On his way north to Saranac Lake he went to the Johns Hopkins Hospital, where the Wassermann and gonorrhea-fixation tests were found negative. On his arrival at Saranac Lake he was not below normal weight, had considerable cough and expectoration, and an afternoon fever of 100° to 101°. The chest examination showed a hyperresonant note over the left side, fair breathing, and coarse rales over the